AN ADEQUATE DIET

STILES

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CAMBRIDGE
HARVARD UNIVERSITY PRESS

LONDON: HUMPHREY MILFORD
OXFORD UNIVERSITY PRESS

1922

Third impression

PRINTED AT THE HARVARD UNIVERSITY PRESS
CAMBRIDGE, MASS., U.S.A.

HARVARD HEALTH TALKS

PRESENTING the substance of some of the public lectures delivered at the Medical School of Harvard University, this series aims to provide in easily accessible form modern and authoritative information on medical subjects of general importance. The following committee, composed of members of the Faculty of Medicine, has editorial supervision of the volumes published:

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ACKNOWLEDGMENT

Acknowledgments are due to the W. B. Saunders Company of Philadelphia for waiving contract rights in permitting the publication of this material.

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The Problem

THE past few years have been a period of great and fruitful activity for the biological chemist. When one surveys the results that have been amassed, one feels that the requisites of diet are so numerous as to make failure in nutrition altogether more probable than success; it seems scarcely possible that all the known demands shall be satisfied. But as a corrective upon this impression, we have before us the fact that the human race, without scientific guidance, has maintained through the ages a fair measure of health and power. In view of this one may incline to think that scientific discoveries in the field of dietetics are academic rather than practical.

A judicial mind will hold to a middle course. There need be no discouragement because the requirements are so many; on the other hand, it is not the part of wisdom to discount all that has come from the chemist's patient labor. Even though mankind has survived, we can conceive that human standards may be bettered. If this is true of the race, it is much more conspicuously true of ill-nourished individuals. We must consider in what respects the conditions of modern life have modified habits of diet, and whether, in any instances, the changes have been for the worse.

The case is paralleled by that of the man who begins to consider the possibilities of disease. There are so many maladies to be thought of that the retention of health seems like keeping one's balance on a tight-rope. Yet, if the preservation of health is really a tight-rope performance, there is a factor which gives constant support, the remarkable

stability of health in the normal subject — his *constitution* — which is like a gyroscope in its steadying effect. Here, too, it is rational not to ignore the dangers, but at the same time to recognize our relative security.

The Service of Food

Adequacy of diet is a matter both of quantity and composition. The two phases of the question can be considered to greater advantage, if we first briefly recall the purposes which food subserves. These may be said to be three — *growth*, *repair*, and *operation*. It might be thought that repair would prove to be typical growth, offset by disintegration, but we have recent evidence that growth has features distinguishing it quite clearly from the processes of maintenance.

In the child, a moderate part of the diet is incorporated into the increasing mass of the tissues. Later, when these

are no longer on the increase, a rather small, but perfectly definite, fraction of the food taken is still devoted to compensation for their wear and tear. But, first and last, the major part of the food serves for the operation of the mechanism, and can be correctly described as fuel. The body may be likened to a power-house which had to be built from certain materials, maintained by other supplies, but which is operated, day by day, at the cost of vast quantities of coal. It is clear that, in the long run, the coal may greatly outweigh the machinery and the structure which houses it.

Our analogy is faulty, of course, particularly in that the power-house is not operated until it has been completed, while the human organism is active from early embryonic life, burning fuel, and setting the energy free while its construction goes steadily on. There is another respect, however, in which our compari-

son is entirely justified. For purposes of construction it is necessary to have precisely the right materials; among fuels there is a greater possibility of substitution. Just as the plan of the builder calls for wood in one place, steel in another, and glass in a third, so the development of the human frame requires a larger number of distinct and specific supplies than we realized a short time ago.

Plainly, the diet must furnish material adapted, first to make, and always to maintain, the sum of all the tissues. In other words, it must bear a certain likeness to the body it is to nourish. But it need not be rigidly similar, for the cells have a capacity to transform certain compounds into others. Thus it is possible to make haemoglobin, the valuable red pigment of the blood, from vegetable substances which seem quite remote from it in their chemical nature. A hundred years ago physiologists thought that animals had to obtain all their

necessary constituents, ready-formed, from the plant world. This is by no means the case; many syntheses are carried out by animal tissues. Yet the constructive power has its limits, and sometimes these are unexpectedly manifested.

Traditional Standards

There are two standards by which, in the past, diets have been appraised. One of these is the fuel value. It is clear that this is one criterion which must be satisfied, though it does not by itself show that a ration is sufficient; it is merely a measure of quantity, and not an indication of suitable composition. The unit of fuel-value is the large calorie, which is primarily a standard quantity of heat. Since one form of energy can be converted into another, the calorie may stand not only for heat but for *work*, which is the second great item in the dynamic output of the body.

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The heat value of an average diet may be set down as twenty-five hundred calories *per diem*. This is for an individual doing but little physical work. The allowance for such subjects may be scaled down to two thousand but must be increased for those whose labor is heavy. Farmers, the world over, seem to require about thirty-five hundred calories. A maximum in the vicinity of seven thousand has been recorded for the Maine lumberman. It is interesting to note that an alcohol lamp, burning a pint of its proper fuel in twenty-four hours, is as large a source of heat and, potentially, of other energy as an average man.

Protein

The second standard by which diets have been judged is their protein content. Proteins are the compounds in our foods which most nearly resemble the leading constituents in muscles, glands, and living tissues generally. There is no doubt

of their peculiar importance for growth and for the upkeep of the organs, but it has proved difficult to fix upon the ideal amount for these services. Most people, choosing their food with no thought of its nature and guided only by appetite, take from two to three ounces (fifty-six to eighty-four grams) daily. It has commonly been held that a selection so widely concurred in cannot be far wrong. Are we always safe in assuming that the average practice is the best possible ?

It may be urged that the lower animals have no guide but instinct. If they are well nourished, cannot man be trusted to choose his food ? This does not necessarily follow. Man " has sought out many inventions," and instinct becomes an uncertain counsellor when in the midst of artificial conditions. It is, in fact, true of domestic animals that the agriculturist may select a ration that is probably better for them than any fo their own choosing.

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We may assume that our remote ancestors had a restricted choice of food, that they were frequently on short commons, and that they were seldom tempted to eat merely to enjoy varied flavors. Appetites adapted to their lot would lead to over-consumption if inherited by descendants having access to food of many kinds. This argument may be applied either to the question of total quantity or to that of the protein allowance. Sylvester Graham thought that a meal should consist of but one course, and there is, perhaps, no better safeguard against over-eating than this simple principle.

If proteins were of no use but for construction like the bricks, tiles, and glass brought to our hypothetical powerhouse, there would evidently be no value in an excess over the current requirement. They are actually more adaptable than this; they are more like lumber which can be turned to account as a

fuel supply if not needed for building material. A strong suggestion is conveyed that such use of proteins is somewhat extravagant, and this is probably just. The objections to the consumption of much protein food may be concisely stated.

Auto-Intoxication

These objections fall into two classes. First, we have to reckon with certain peculiarities of proteins when they are acted upon in the alimentary canal. All types of food undergo decomposition — as distinguished from digestion — while in the intestine. The extent of the changes is probably greatest in the case of the sugars, and least with the fats. Proteins are intermediate in the degree of their decomposition, but it is well established that the products arising are peculiarly harmful. Certain of the products, carried far and wide by the circulation, have power to injure the general

health. Any form of disturbance due to them may be called a symptom of *auto-intoxication.*

Certain mild effects have long been referred to this source. Among them have been headache, drowsiness, and quick susceptibility to fatigue. It is now believed that much graver ills may originate from abnormal decomposition in the tract, and the entry of poisons into the system. Troubles with the joints, anaemia, and serious nervous disorders may be mentioned. It is clearly important in all such cases to keep down the protein of the ration. The decompositions which do so much harm result from the activities of the swarming micro-organisms of the intestine. Our natural defense is the prompt absorption of the products of digestion and the consequent absence of a lagging surplus.

In addition to the drawbacks of a protein excess in the canal, we must recognize that bad effects may arise

from such excess, even though the protein be perfectly digested and absorbed. In the normal course of events, all the starch, and the several sugars, which we eat will be offered to the tissues in the form of simple sugars (two or three varieties). All the fat of our food will figure again as fat when transferred to the blood. When, later, sugars and fats are burned (oxidized) under the usual conditions of life, only two products arise. These are carbon dioxid and water. Their removal is a simple matter: the carbon dioxid passes out in the breath; the water blends with a much larger volume which is always passing through the body, and is cared for by all the channels of excretion.

It is otherwise when protein is treated as a fuel. Carbon dioxid and water are indeed formed, but other products inevitably accompany them. These have to be dealt with by the kidneys. We may roughly liken the burning of sugar

and fat to the use of gas for fuel; while protein seems more like coal. When we burn gas, we have only to look to our draught or ventilation; a coal fire leaves us its ashes as an additional care.

Enough has been said to justify much of the present day teaching, to the effect that definitely high protein diets are undesirable. It is nearly as plain that nutrition may suffer from a scant protein supply. It is by no means established that the minimum is the optimum. Doctor Samuel J. Meltzer has discussed this question from an original standpoint, and it may be worth while to recount his argument.

When an engineer plans a bridge, he does not aim to have its strength just sufficient for the strain it will probably have to bear. He designs it to be much stronger than this. If he makes it capable of sustaining three times the anticipated load, the "factor of safety" is said to be three. In a very real sense,

the human body has its factors of safety, and they are generous ones. For example, a man has two lungs, but can exist with one. He can survive the loss of one kidney. His alimentary canal can be much shortened; many believe that he would be better off without the colon.

Doctor Meltzer states these facts, and then asks whether any one can seriously maintain that a man is better off with his organs so reduced than with the entire equipment. If it is desirable to have organs which are not strictly indispensable, is it not reasonable to give them somewhat more than a bare minimum of work to do? Certainly no one will claim that the best course for the muscles in general is to use them no more than is absolutely necessary. Is it then best to spare the alimentary tract, the liver, and the kidneys every whit that can be subtracted from their duties? The reasoning is ingenious

and suggestive, though perhaps not unanswerable.

The danger to be apprehended from too little protein is in the nature of a general decline of vitality and resistance. The results may be like those of poverty, or they may recall the lack of initiative and vigor characteristic of certain ill-fed races. But it is probably true that the prevalent error is over-consumption. This is more markedly the case with men than with women, and most flagrantly with those in easy circumstances who are much in hotels and clubs.

The nutritive worth of the proteins in various foods is not perfectly uniform. It is generally believed that those in meat, milk, rice, and potato are of a superior type. One or more of these foods will enter into any ordinary diet, and the danger of suffering from an unwise selection of proteins is rather remote. The emphasis seems to be shifting from the specific merits of par-

ticular proteins to inequalities of food values arising from the presence or lack of minor constituents. We must pass on to this subject.

The Value of Minor Constituents

There are but few articles of human consumption which do not prove, upon chemical investigation, to be mixtures of many compounds. Even our drinking water contains salts and other bodies in solution. Cane-sugar comes as near being a single pure compound as anything we eat, and this it is our practice to combine with other foods. Sugar has been condemned for the very reason that it is a purified and homogeneous compound, and therefore not a "natural" food. This does not seem an impressive argument, so long as there are many contrasting foods in the diet, but it is certain that we cannot go on indefinitely reducing the number of com-

pounds without sooner or later excluding something essential to nutrition.

The minor constituents, in which there is so much interest at this time, are partly organic, and partly mineral. The belief that mineral supplies in a certain variety are necessary to health is not new. During growth it is as truly requisite to provide these as to furnish the proteins themselves. The ash left behind when milk is first evaporated and then burned has been shown to be marvellously adapted to its special service, the production of standard tissue. The organic ingredients of the accessory class deserve rather full treatment.

They are useful, first of all, because to a great extent they determine the palatability of food. This is very far from being merely an aesthetic consideration. Meals must be relished if they are to be well digested. Proteins, starch, and fats in pure condition are tasteless, and aside from the sweetness of the sugars, all the

numberless flavors we enjoy are due to the accessories, mineral and organic. The latter are much the more important, for the salts are odorless. Some of the extractives, notably those in meat, directly stimulate the lining of the stomach so as to promote the secretion of the gastric juice.

But the accessories are not significant for digestion alone; they have a most striking relation to nutrition. Their presence in suitable assortment is imperative. The recognition of this fact is clearing up many matters that have been perplexing. It has been hard to account for the obvious inequality in nutritive value which is often demonstrated for diets equivalent in calories and protein content. It has been clearly shown that of two such diets one may be ample for all purposes, and the other inadequate, simply because the first contains minute quantities of substances not found in the second.

Reference has been made to Sylvester Graham. We shall do well to examine one of his chief doctrines which is enjoying something of a revival in our day. The flour which bears the name of Graham contains all parts of the wheat kernel, the husk as well as the interior. This reformer taught that by rejecting the husk we might fail to obtain some essential fraction of the food. This was a shrewd induction. It has been definitely proved that when the envelope or pericarp of rice is discarded, the grain ceases to be a complete food for pigeons. An active principle can be prepared from the pericarp which will perfectly remedy the deficiency when supplied in minute quantities.

What goes wrong in the economy of the pigeon which is restricted to a diet of polished rice? The question can be answered with some precision. The compound which the ration fails to furnish is needed most urgently by the

nerves. If it is not afforded by the food, a limited supply can be had from other tissues of the body, but at a heavy cost: the structures levied upon disintegrate. It is as though bolts were removed from one machine to repair another with the result that the first fell to pieces. When the nerves can no longer be sustained, even by this ruinous process, they become definitely diseased.

Beri-Beri

The failure of nutrition in the pigeon is believed to correspond rather closely with the disease of man known in the East as beri-beri. People restricted by habitat and poverty to a monotonous diet are sometimes observed to lose rapidly in weight and strength, and then to develop acute nervous lesions (polyneuritis). Beri-beri has always been banished from communities in which the food-supply has become more ample and inclusive.

Scurvy

Similarly, it has been believed that scurvy is a deficiency disease. The chronicles of explorers abound in instances of this distressing malady. The victims have been prostrated, have suffered intensely from sore mouths, have had haemorrhages under the skin, friable bones, and a long list of other symptoms. Various articles, such as lime-juice and potatoes, have seemed to be efficacious in warding off and relieving scurvy. Some have contended that scurvy is a form of poisoning due to products of decomposition developing in the food. It seems more in accord with the facts, however, to assume, not that the food has come to contain a poison, but that some valuable constituent has disintegrated. The lime-juice or the potato, then, does not convey the antidote to a poison, but rather an ingredient similar to that one which has been lost.

VITAMINES

It has been proposed to call the valuable substances for want of which beri-beri, scurvy, and other disorders arise, by the name of *vitamines*. An *amine* is a nitrogenous compound of a certain type, while the prefix suggests that a vitamine is such a compound as is necessary to life. The objection has been raised that the term is too specific; we do not know that all such bodies are amines, nor even that they are nitrogenous; it is probable that some of them are neither. Hence it seems better to call them accessory substances, and not to insist on a chemical classification.

Let us now consider quite fully in what ways the human system may fail to receive any of the supplies necessary to its welfare. The suggestion from beri-beri is to the effect that this may happen when the selection of food is too restricted. Furthermore, we recognize

the possible impairment of food-values by refining. But we may repeat that there can be no serious objection to this refining when it is applied only to a moderate part of the diet.

A condition which many hold to be analogous to beri-beri is the grave disorder, pellagra. This is a disease of gradual development. The early symptoms are confined to the skin; later, the manifestations are widespread, and at the last violent insanity may supervene. Pellagra has long been recognized in Mediterranean countries, and its presence in our own Southern States is now frequently reported. It is generally found to have attacked those whose food is of but few kinds. Like beri-beri, it is usually arrested if the diet is enriched. Meat and milk are especially beneficial. It is, however, not yet certain that pellagra is a deficiency disease. When a number of people closely associated suffer from a disorder, the first impres-

sion is that it has spread among them as an infection; but we have also to consider that it may be the uniformity of their environment and diet, rather than their contact, which has led to like effects in many individuals. These alternatives in the case of pellagra are still being debated.

Cooking

So far we have dwelt upon two conceptions: first, that nutrition may suffer from a narrow selection of food; second, that long keeping may result in a loss of accessories. Are there still other conditions to be reckoned with? It may properly be asked whether cooking may not have some damaging influence. There are those who actively advocate uncooked rations, and who themselves live on fruits, nuts, and greens, perhaps making use also of milk. Here, as in many another extreme teaching, we can discover a measure of truth. Some

valuable substances in food may very probably be destroyed by strong heating.

But we need not hasten to join such a cult. The most that we are required to concede is that we ought to eat a fair amount of raw food. We need not forego the great advantages which, in the case of many articles, are secured by cooking. These include development of flavor, the breaking open of vegetable cells to permit the digestion of their contents, and, above all, the destruction of disease-producing germs. Cooking greatly extends the range of our choice, and we have been urging all along that safety is found in inclusiveness.

Faulty Assimilation

When nutrition, in spite of the best and most varied fare, falls short of success, we may think of still another possibility. Just as foods may be impaired by radical or gradual decomposition before they are eaten, so they may deteriorate in a dis-

astrous manner before being absorbed. The slip may not come between the cup and the lip, but between the lip and the circulation. We have often to remind ourselves that what is within the intestine is not yet within the body; it is merely in contact with its surface, and subject still to accidental alterations.

Finally, it is possible that all the materials needed for the nutrition of the body may be presented to the cells whose duty is to absorb them, and the last step may fail to be taken. In other words, there may be faulty assimilation. When a baby does not do well, this is probably the case. The fact that the milk was originally adequate may be shown by the successful nutrition of other infants having the same supply. Non-success, in a particular instance, may be due either to an unfortunate type of intestinal decomposition or to deficient absorption.

While we have to admit this possibility, we ought at the same time to

point out how loose are many statements commonly made regarding variations in assimilation. It is often suggested that one person gets "more of the goodness of his food" than does another. In this way the attempt is made to explain why reputed large eaters sometimes remain thin. But the evidence goes to show that individual differences between persons in fair health are never striking. That is to say, they are not large in a quantitative sense.

Percentile Absorption

The alimentary canal, even when seriously mistreated, usually retains a high degree of efficiency. Unless food is of a very intractable character, not more than ten per cent goes to waste. Sometimes the loss by imperfect absorption is as little as five per cent. It is therefore absurd to talk of improving absorption by fifty or a hundred per cent. Little absolute gain, in this respect, can be

hoped for as a result of prolonged mastication or any other special practice. Nevertheless, as we have implied above, a slight improvement as measured by percentage may have a material influence on nutrition, some accessory which previously escaped the organism being secured for its service. It would not be wise, however, to make much of this suggestion, which is frankly speculative.

Summary

It will be well now to recapitulate the points which have gone before. The diet must satisfy the fuel requirement of the body. It must furnish suitable proteins, and it is better that these should be derived from numerous, rather than a few sources. (This does not mean that a single meal should be complex, but that there should be variety from day to day.) Mineral matter is a definite need. An unknown number of accessories are

required if all is to go well through long periods of time. It may not at present be possible to know in every instance whether a given food possesses virtue by reason of its organic or its mineral composition.

Perhaps we need not add further to the list of absolute requirements; but there are other desiderata. Some of these are so obvious that they may be passed over with a word. The importance to us of food which appeals to the appetite should be plain without an argument. It may be said that we should eat what we like. Our liking is, as a rule, the guarantee of digestion. Yet, recalling our plea for inclusiveness, we are bound to add at once that they are fortunate who like a great many kinds of food.

Roughage

We speak of certain foods as relatively indigestible. What we usually mean is

that the articles in question cause discomfort or downright disturbances. Many people have perhaps never reflected that a certain amount of totally indigestible matter may be harmless, if not advantageous. The distinct usefulness of a moderate quantity of husk and woody fibre is generally affirmed. Granting that we may extract certain accessories from such a source, we must still admit that the mass of the material makes no contribution to the body. It has been spoken of as " ballast," and also as " roughage."

In what ways can indigestible matter be helpful ? The assumption is commonly made that it stimulates the intestinal lining by direct contact and provokes a vigorous muscular reaction. This may not be precisely the way in which roughage corrects the evils of constipation, but there is little doubt that the general influence is good. We may suppose that such material, as it is

moved along the alimentary canal, catches and takes with it accumulations which might not otherwise have the necessary bulk to be acted upon. Its function would thus be amusingly like that of the saw-dust which the janitor throws upon the floor before sweeping.

It may be possible to include too much roughage in the ration, but the opposite practice is probably more common. The principal substance which can figure in this rôle is cellulose, an indigestible compound furnished most abundantly by fruits and coarse vegetables. The agar-agar preparations often used to overcome constipation are substitutes for cellulose, or, in its presence, may supplement and reinforce it.

In this connection it should be pointed out that the deliberate choice of foods containing a maximum of innutritious matter is favorable to weight reduction, for rations distinguished by bulk rather than actual food value may fairly well

appease the appetite, while failing to meet the full needs of the tissues. The fat man can replace his bread and butter, potato, pastry, and candy with salads, greens, and fruits, but he may be obliged to continue his new regimen as long as he lives.

Fuel Foods

What shall we say of the fuel foods? These enter the body, not to become an enduring part of it, but to be oxidized to supply current needs. We have implied that when this is the service to be performed the substitution of one type of food for another can be quite freely practised. The obvious question is as to whether any fixed proportion between fats and carbo-hydrates can be decisively recommended; but about this matter it seems impossible to make dogmatic statements; the ratio has to be determined largely by individual tastes and the capacity of the subject to assimilate

one kind or the other. There is also an economic consideration; carbo-hydrates are, in general, much cheaper than fats.

The fact is familiar to the dietitian that fats and carbo-hydrates have very different fuel values. If an ounce of fat is to be replaced with carbo-hydrate, it will not answer to supply an ounce of the latter; it will take more than twice as much to provide equivalent energy. The technical statement is that a given weight of fat is *isodynamic* with about two and a quarter times as much starch.

Starch and Sugar

A word may be said about the differences between starch and sugar. These two orders of carbo-hydrates are nearly related; in the plant world the change of one into the other is continually taking place. The starches are relatively insoluble; the sugars dissolve freely. In the course of digestion, starch is changed to sugar. The student, on learning this,

naturally asks why the sugar might not have been eaten instead of the starch, and the digestive transformation omitted, but reasons for preferring to use a good deal of starch are not difficult to find.

Highly soluble bodies are always irritating to living membranes. This is readily recognized in the case of salts. In the case of the sugars, it is really demonstrated by their sweetness; for the stimulation of the organs of taste is an example of irritation. Starch, which does not give rise to sensations of taste, is correspondingly unstimulating to the cells in general. The formation of sugar from starch in the canal is a relatively gradual process and cannot produce a concentrated solution, provided absorption fairly keeps pace with it. The advantages of starch over sugar as the chief carbo-hydrate of the diet should be apparent.

Alcohol

Is regularly consumed by millions of human beings in quantities which give it a material importance in the diet. A recent writer (Dodge) points out that alcohol makes a larger contribution to the fuel value in multitudes of cases than protein does. This is likely to be true whenever the daily consumption of alcohol is in excess of two ounces. People who use alcohol to this extent presumably eat less carbo-hydrate and fat than they would if abstaining; otherwise, they would become corpulent. To admit that alcohol may bear its part among the other fuels, is not to ignore the drawbacks and possible dangers of its inclusion.

Over- and Under-Feeding

Finally, we may give some attention to the results of general over- and under-feeding. We have already discussed high and low protein standards. It

remains to compare the effects of excessive and deficient calorific supply. Certain persons are reputed to be large eaters and others to get along with a little. No doubt, we usually exaggerate the degree of contrast, but moderate differences appear to exist. One person may live upon a scale of twenty-five hundred calories, while another, with similar "build" and occupation, may find two thousand sufficient.

Numerous experiments have shown that what is called the "basal metabolism" — the energy requirement during rest and fasting — does not vary much among healthy subjects. There are probably more distinct personal differences when work is performed or low temperatures are encountered. Some organisms may be more economical and efficient than others. When we see a florid man, we are apt to guess that he is a heavy eater. It is possible that he has inherited a system which is prodigal

in dispersing heat, and that his dietetic habits are necessary to its upkeep. If it is true that such conditions occur, they may remind us of the poorly built and draughty houses which call for such a great consumption of coal to warm them.

If we grant that some people need more food than others under like circumstances we have still one important indication to consider, namely, body-weight. The reliability of appetite is impressively shown, in the great majority of cases, by the constancy of the weight through long terms of years. A very small surplus of income over oxidation, day by day, will soon result in obesity, while an equally small deficit will lead to emaciation. It is not strange that these imperfect adjustments should be frequently observed. The most common instance is the persistence of an appetite suited to an active life into years of lessening oxida-

tion. The resulting increase of weight is in every way undesirable.

What are the characteristics of the over-fed and the under-fed? While there are probably exceptions to the rule, the two types may be expected to appear somewhat as follows. The first is heavy, and of a high color. The man of this class is a deep sleeper, and dislikes to get up; he is an optimist, but not remarkably persevering. The sparingly fed individual is consistently opposed to the liberally nourished at every point. He is under weight, and often deficient in color; a light sleeper, if not actually troubled by insomnia; and sensitive to cold. As a worker he may be diligent and efficient, though the temperament exhibited is likely to be conscientious rather than enthusiastic.

The high degree of endurance often noted in men and women who eat lightly affords the strongest argument in favor of such self-denial. It is probably to be

explained by two circumstances. First, the intestine is to an exceptional degree free from injurious residues. Second, the blood and other body-fluids are correspondingly free from avoidable by-products of metabolism. The resistance to fatigue secured is greatly to be coveted, but it is not unlikely that the cutting down of the food is often too rigorous. Depression of spirits is a common sign that the diet should be made more generous.

A Few References

Lusk, *The Fundamental Basis of Nutrition*. Yale University Press, 1914.

Mendel, *Changes in Food Supply*. Yale University Press, 1915.

Sherman, *Food Products*. Macmillan, New York, 1914.

Bailey, *Source, Chemistry, and Use of Food Products*. Blakiston, Philadelphia, 1914.

Meltzer, "The Factors of Safety in the Animal Structure and Economy," *Jour. of Amer. Med. Assoc.*, 1907, vol. xlviii, p. 655.

Chittenden, *Physiological Economy in Nutrition*. Stokes, New York, 1904.

Lusk, *Elements of the Science of Nutrition*. Saunders, Philadelphia, 1909.